

## Photonics-Based Quantum Technology

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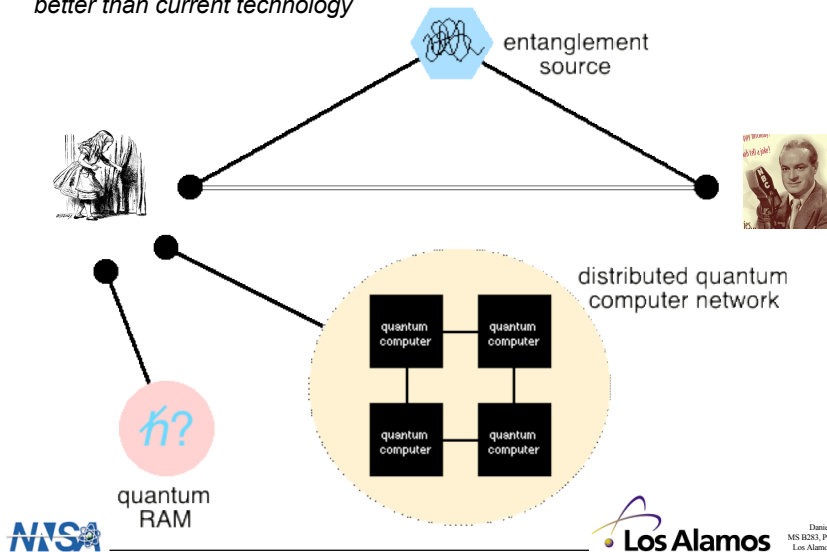
**Abstract:** It is now generally realized that the exploitation of fundamentally quantum mechanical phenomena can enable significant, and in some cases, tremendous, improvement for variety of tasks important to emergent technologies. Because of decades of successes in the experimental demonstration of such fundamental phenomena, quantum optics is playing a preeminent role in this endeavor; indeed, many of the objectives of quantum technologies are inherently suited to optics (e.g., communications, remote sensing), while others may have a strong optical component (e.g., distributed quantum computing, quantum repeaters). With our collaborators both within LANL and at other institutions worldwide, we are exploring various aspects of the development of photonics-based quantum technologies, in particular: entangled state preparation and characterization, high efficiency single photon detectors and Bell state analysis of photon pairs; optical based readouts for spin-based solid state quantum computers; optical probes for quantum phenomena in semiconductors; and the physics of cold trapped ions.



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## Goals of Quantum Information Technology

*Exploit quantum phenomena to communicate, process and store information better than current technology*



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## •Photons in quantum information

- *history: decades of achievements in quantum optics.*
- *optical communications: compatibility with existing technology.*
- *central role in many quantum information architectures.*
- *measurement and control of Quantum Computers: ion traps, solid state.*
- *diagnostics for solid state quantum technology.*

## MY recent/current research activities

### •Quantum Photonic Technology

- *preparation and characterization of entangled states.*
- *measures and limitations of entanglement.*
- *high efficiency photon detectors.*
- *noise in PCM-based QKD systems.*

### •Quantum Computing

- *Phonon-phonon interactions in ion traps*
- *cantilever-based quantum bus for SSQCs.*



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## •Future directions

- *Novel QIP architecture based on neutral atoms (Timmermans)*
- *Bell state measurements.*
- *entangled light as a probe of quantum phenomena in semi-conductors.*
- *new types of trapped ion QIP protocols.*

## •Goals for Photonic QI Systems

- *single photon and entangled pair sources.*
- *high-efficiency photon detectors.*
- *generating and measurement of entangled states.*
- *Bell state measurements.*
- *quantum memories and repeaters.*



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